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Final Report

Widening the coverage of PAT Scheme

Sectoral Manual - Ceramic industry

Prepared for

Shakti Sustainable Energy Foundation

teri The Energy and Resources Institute

...towards global sustainable development

SHAKTI SUSTAINABLE ENERGY FOUNDATION

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This report is part of Shakti Sustainable Energy Foundation (SSEF) and The Energy and Resources Institute's (TERI) attempt to study the ceramic sector energy consumption trends and energy efficiency improvement opportunities in the ceramic sector in India. The views expressed in this document do not necessarily reflect the view of Shakti Sustainable Energy Foundation. The organization accepts no liability for the content of this document, or for the consequences of any actions taken on the basis of the information provided. While every care has been taken in compiling this report, TERI and Shakti Sustainable Energy Foundation accepts no claim for any kind of compensation, if any entry is wrong, abbreviated, omitted or inserted incorrectly either as to the wording space or position in the report.

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The Energy and Resources Institute (TERI) places on record its sincere thanks to the Shakti Sustainable Energy Foundation for providing opportunity to undertake the study on "Widening the coverage of PAT scheme for Ceramic Sector" which was quite challenging and very interesting. The conclusions of this study are expected to support the Foundation which is active on the areas to strengthen the energy security of India by aiding design and implementation of policies that support energy efficiency and renewable energy.

The Energy and Resources Institute (TERI)

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List of Abbreviations

BEE	–	Bureau of Energy Efficiency
BSM	–	Billion Square Meter
CAGR	–	Compound Annual Growth Rate
CGRI	–	Ceramic & Glass Research Institute
CII	–	Confederation of Indian Industries
CMIE	–	Centre for Monitoring Indian Economy
CTA	–	Customs Tariff Act
CWF	–	Climate Works Foundation
DC	–	Designated Consumer
DIC	–	Directorate of Industries and Commerce
ESCerts	–	Energy Saving Certificates
FHRAI	–	Federation of Hotel and Restaurant Associations of India
IBEF	–	India Brand Equity Foundation
ICCTAS	–	Indian Council of Ceramic Tiles and Sanitaryware
ICRA	–	Indian Credit Ratings Agency
ITC	–	International Trade Centre
MSF	–	Million Square Feet
MSM	–	Million Square Meter
toe	–	Tonnes of Oil Equivalent
MT	–	Metric Tonnes
MTPA	–	Metric Tonnes Per Annum
NAPCC	–	National Action Plan on Climate Change
NMEEE	–	National Mission on Enhanced Energy Efficiency
PAT	–	Perform Achieve & Trade
RSIDICL	–	Rajasthan State Industrial Development and Investment Corporation Limited
SCM	–	Standard Cubic Meter
SEC	–	Specific Energy Consumption
SIDBI	–	Small Industries Development Bank of India
SME	–	Small and Medium Enterprises
SSEF	–	Shakti Sustainable Energy Foundation
TERI	–	The Energy & Resources Institute
TPA	–	Tonnes Per Annum
VFD	–	Variable Frequency Drive

Executive Summary

The ceramic industry in India is about 100 years old. Ceramic products are manufactured both by large and small enterprises with wide variance in type, size and standards. Though ceramic manufacturing units are spread across India, most of the units are concentrated in Morbi, Surendranagar and Khurja. Only a few units have a state-of-the-art-technology, and manufacturing facilities for production of quality ceramic goods. All sub-segments of Indian ceramic industry, viz., tiles, sanitary ware, tableware, ornamental ware, etc have both organised and unorganised players, with the latter having substantial share in production.

The ceramic tile industry in India emerged in the late 1950s with H&R Johnson setting up its plant for manufacture of wall tiles at Thane. This was followed by Somany Pilkington, Spartek Ceramics, Regency Ceramics, Kajaria Ceramics, Murudeshwar Ceramics, Bell Ceramics and many others. The ceramic tile industry can be broadly categorised into wall tile, floor tile, vitrified tile and industrial tile segments. Their market shares (in value terms) are estimated to be around 20%, 23%, 50%, and 7% respectively. The tiles are available in a wide variety of designs, textures and surface effects. They cater to tastes as varied from rustics to contemporary marble designs in super glossy mirror finishes. The potential for the industry is significant considering the per capita consumption of ceramic tiles in India. Currently it is at 0.50 square meters per person in comparison to over 2 square meters per person in peer countries like China, Brazil and Malaysia.

In India there are about 13 major ceramic players in organized sector and 25 ceramic plants in unorganized sector with capacities varying from 1.6 to 54 million square metres (MSM). The average capacity utilization of the major players in ceramic industry is about 75%. The energy consumption of the ceramic industry is dependent on different factors such as type of products, capacity utilization, type of fuels used, technology adopted, etc. The estimated annual energy consumption of these 38 ceramic plants varies between 3000 toe to 50000 toe. Of these, the annual energy consumption of 36 plants is estimated to be more than 5000 toe. This energy consumption level is more than the minimum annual energy consumption for designated consumers (DCs) set for textile industries. Therefore it is suggested that these 36 plants may be included as DCs under the PAT scheme with a threshold limit of 5000 toe as the minimum annual energy consumption per plant (figure 6.1). There exists an energy saving potential of 5–14% by adoption of energy efficiency measures in process and utilities.

1.0 Introduction

The Ministry of Power and BEE are entrusted with the implementation of the NMEEE under NAPCC. One of the key components of the mission is PAT mechanism. This is a market based mechanism to improve the energy efficiency in large energy intensive industries and facilities cost-effectively by certifying energy savings that could be traded. The PAT mechanism is designed to facilitate the DC's to achieve their legal obligations under the EC Act in 2001, which was later amended in 2010.

The ensuing PAT scheme applies to 8 industrial sub-sectors, which are Power Plant, Aluminium, Pulp & Paper, Chlor- Alkali, Cement, Iron & Steel, Textile and Fertilizer. During the first phase of the PAT cycle (3 years starting from 1st April 2012), as per the recent notification, about 478 DC's have been identified. They are obliged to reduce their energy consumption by a specific target given by BEE. The expected energy savings from this scheme is about 6-8 million Mtoe in this period. The over achievers will earn tradable ESCerts whereas under achievers will be liable to comply the same through purchase of ESCerts or by paying penalty.

The BEE plans to widen the coverage of the PAT scheme, in subsequent phases, by adding more new industrial subsectors depending on energy consumption. For new industrial segments there is a need to study the energy consumption in detail to establish the threshold limit for the eligibility for DCs. SSEF operates as a partner institution of the CWF and has been focusing its efforts on clean and secured energy future for all in India. SSEF in consultation with TERI is assisting BEE in widening the net of the PAT scheme by adding new subsectors in subsequent phases of the PAT scheme. Under this, SSEF has identified four subsectors to study the energy consumption in detail so as to establish the threshold limit for the eligibility as DCs. The identified industrial subsectors for the study are given below.

- Copper
- Zinc
- Glass
- Ceramics
- Sugar
- Vegetable oil refineries

Mapping the identified four sub sectors in the Indian context and preparing broad sectoral report is the initial task. This subsector overview report covers information on large & medium manufacturers, number of plants existing, production capacity, technology types and technological development in the last decade, capacity utilization, energy efficiency levels, estimated energy saving potential and regulatory and policy issues having a bearing on improving the efficiency in the sector.

The purpose of the sectoral report is mainly to understand the energy intensity of the subsector, technology adopted and its energy efficiency levels. It also assesses the potential for reduction in energy consumption across the subsector and technological gaps. It provides an overall energy scenario about the subsector to all the stakeholders. This overview report is prepared based on secondary information available in public domain.

Information and data were also collected based on interactions with industrial associations of the subsector. The report consists of the following chapters:

- Overview of the Ceramic Sector
- Sector Energy Consumption
- Policy and Regulatory aspects
- Conclusions

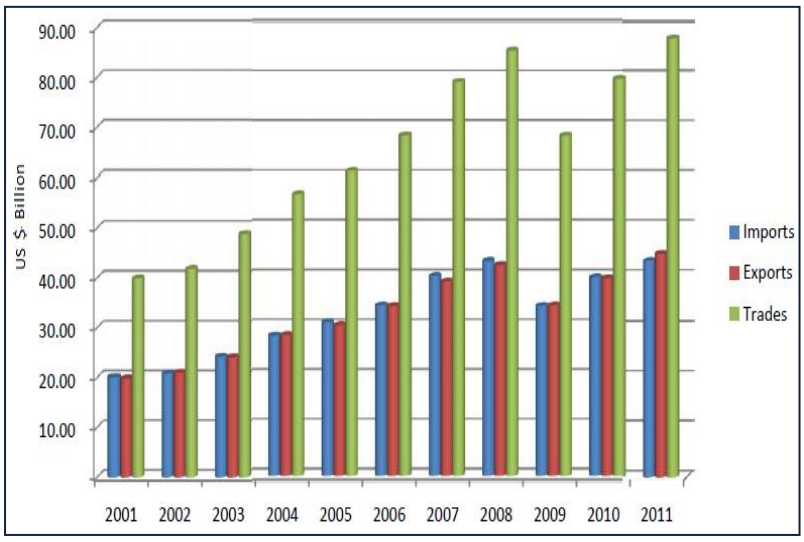
2.0 Overview of Ceramic Industry

2.1 Sector importance

Ceramic Industry in India is about 100 years old and has played a major role in the progress of humankind. It comprises mainly ceramic tiles; sanitary ware & tableware. Ceramic products are manufactured both in organized and unorganized sector with wide variation in type, size, quality and standard. As on 2012, India's share of world production is 600 MSM and ranks at 3rd position in the world in terms of production. Global industry growth rate is 11% and growth rate in India domestic market is 15% as on 2012. A total of over 5, 50, 000 people are employed in the sector. Ceramic sector makes an important contribution to the economy, housing sector, export earnings and employment of India. With the growth in the housing sector the demand of ceramics is expected to increase considering the competitiveness of Indian tiles in the international market. The potential is huge considering the present per capita consumption (0.50 square meters per person) of ceramic tiles in India in comparison to over 2 square meters per person for countries like China, Brazil and Malaysia.

2.2 Global tile industry

During the period from 2001 to 2011, total ceramics trade grew at a CAGR of 7.56%, from US$ 39.6 billion to US$ 87.9 billion. During the period exports increased from US$ 19.8 billion to US$ 44.6 billion (CAGR of 7.74%), while imports increased from US$ 19.9 billion to US$ 43.2 billion (CAGR of 7.38%). China is the largest trader of ceramics in the world, with total trade of US$ 14.7 billion during 2011, followed by US and Germany, Italy with total trade of US$ 7.4 billion, US$ 7.0 billion and US$ 6.18 billion, respectively.



Source: ITC, Geneva

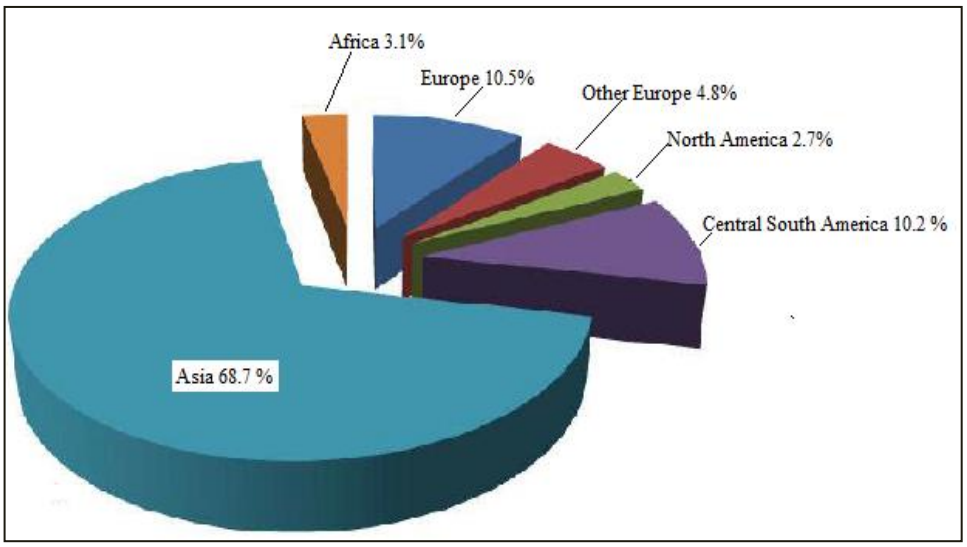
Figure 2.2.1: World Ceramic Trades

Table 2.2.1: Global Production of Top Manufacturing Countries

In MSM

Country	2008	2009	2010	2011	2012
China	3400	3600	4200	4800	5200
Brazil	713	715	753	844	866
India	390	490	550	617	691
Iran	320	350	400	475	500
Spain	495	324	366	392	404
Italy	513	368	387	400	367
Indonesia	275	278	287	317	330
Vietnam	270	295	375	380	298
Turkey	225	205	245	260	280
Mexico	223	204	210	219	229
Total World Production	8594	8581	9619	10596	11166

Source: Ceramic World Review



Source: Ceramic World Review

Figure 2.2.2: Global Production Scenarios

In 2012 world tile production crossed 11 BSM mark to reach at 11166 MSM. Asia produced 7674 MSM – up 6.4% over 2011.

Table 2.2.2: Global Consumption of Top 10 Countries

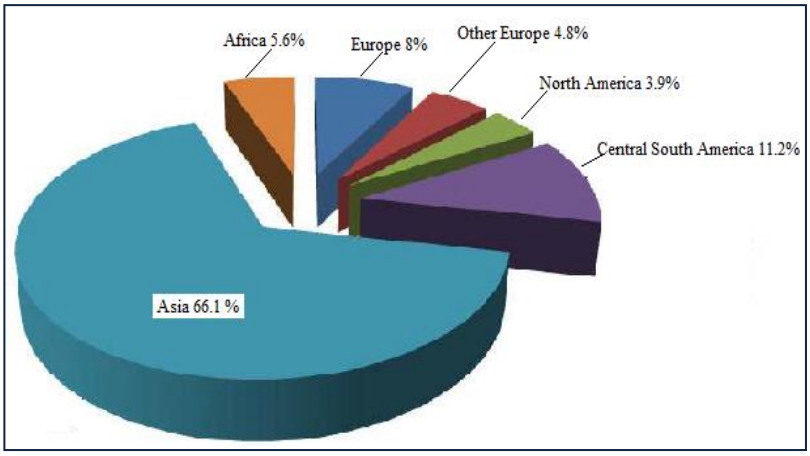
In MSM

Country	2008	2009	2010	2011	2012
China	2830	3030	3500	4000	4250
Brazil	605	645	700	775	803
India	403	494	557	625	681
Iran	265	295	335	395	375
Indonesia	262	297	277	312	340

In MSM

Country	2008	2009	2010	2011	2012
Vietnam	220	240	330	360	247
Saudi Arabia	136	166	182	203	230
Russia	191	139	158	181	213
USA	211	173	186	194	204
Mexico	177	163	168	177	187
Total World Consumption	8373	8525	9468	10432	10912

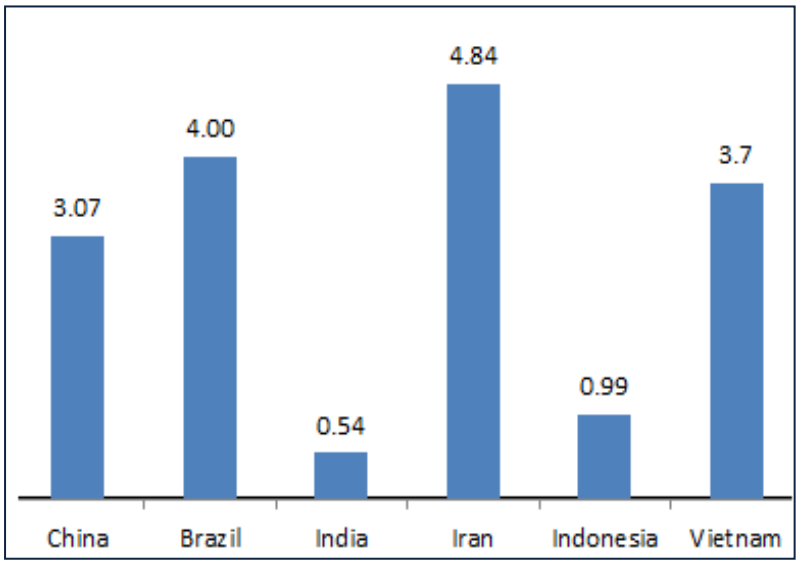
Source: Ceramic World Review



Source: Ceramic World Review

Figure 2.2.3: Global consumption scenarios

The breakdown in consumption by geographical area is very similar to that of production. In Asia, the consumption grew at 4.4% in the year 2012. Global per capita consumption of tile is given in figure 2.2.4 below.



Source: Ceramic World Review

Figure 2.2.4: Global Per Capita Consumption of Tile (MSM)

2.3 Indian Ceramic Industry

(i) Ceramic tiles

Indian tile industry is 681 MSM as of March 2013. Industry size is estimated to be Rs 19500 Crores as of March 2013. The industry has been growing at a CAGR of 13 – 14% per annum in last 4 – 5 years. The growth of the unorganized sector which accounted for 60% of total production bears testimony of the attractive returns from the industry. The organized sector accounted for 40% of total production. Industry ranks in the top 3 in terms of production in the world. Market share of India has risen from a little over 2.7% to 5.6% in terms of ceramic tile production.

(ii) Sanitaryware

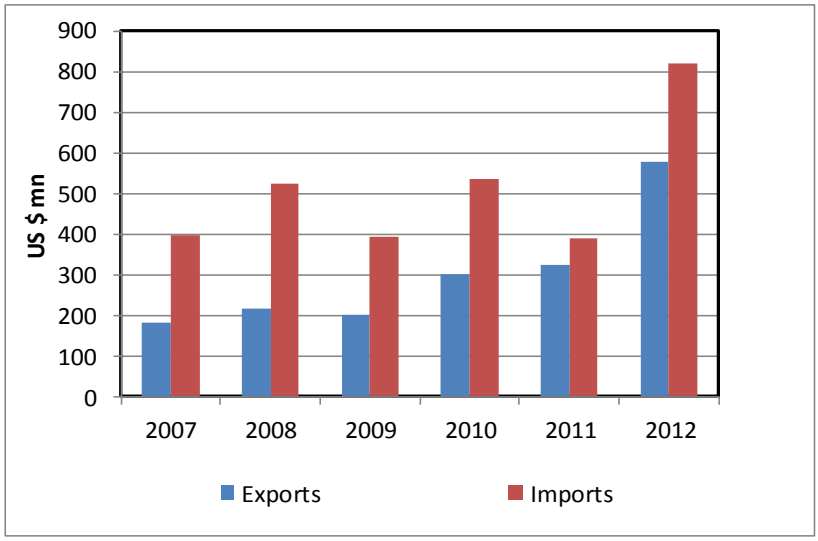
The sanitaryware industry in India is clearly divided into two sectors, the organized and unorganized sectors. In the former, Hindware is market leader with two factory locations followed by Roca which has 4 plants in India. Other large players in this industry are Kohler, Cera, and Duravit. With a total number of nine units, production capacity totals 150000 Million TPA, the actual production, however, stands at around 125000 Million TPA.

In the unorganized sector around 250 companies produce basic sanitaryware under various brand names. Their production capacity totals 500 000 Million TPA, although actual annual production reaches 400 000 Million TPA. They are concentrated in Gujarat because of availability of cheap raw materials and low overheads and hence sell their products in the domestic market cheaper than the products of the organized sector. The industry has been growing by about 15-18% over the last two years. The sanitaryware industry in India has shown dramatic growth over the last 5 years, with major players doubling their production capacity. The current market size of industry is estimated at Euro 350 million.

(iii) Tableware

India is exporting bone china tableware to all the European countries including UK, Canada, Australia and Egypt etc. At present production capacity of bone china tableware in India is 200 MTPD and nearly 25% of total production is exported. New bone china units in India are using latest technology and equipment and even old stoneware industry has come up a long way. Now with latest technologies and upgraded machineries it is ready to become the leading supplier of quality products to the world in 21st Century.

The intrinsic fundamentals of this fast growing segment are estimated to give around 8% to 10% growth for the next decade. Though select players, especially new entrants who come in with the right strategy to tap such a highly fragmented market can look at more than 15% growth for at least 3 to 4 years over existing base. The key point is also that though the market is not nascent it has huge untapped potential. Growth is more in the organized retail segment though on a much smaller base but its share of the market is around 9.5% and growing. Almost 50% of the market is comprised of organized players, with brands like Yera, Ocean, Luminarc, La Opala, JCPL, Bharat, Corelle, Treo and other. India's share of exports and imports in recent years is given in figure 2.3 below.



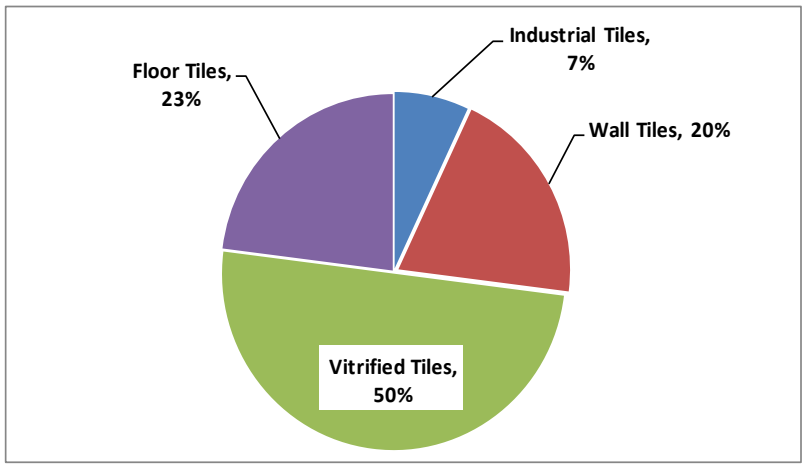
Source: India Trade Statistics

Figure 2.3: India's Exports and Imports of Ceramic Products

2.4 Indian Market Scenario

2.4.1 Present scenario

Over the years, the industry has been modernizing through new innovations in product profile, quality and design to emerge as a modern, world-class industry, to take on global competition. The Indian Ceramic Industry ranks at 3rd position in the world and produces around 6.3 % of global output as on 2013. The market shares in value terms for the main product segments are given in figure 2.4.1.



Source: ICCTAS

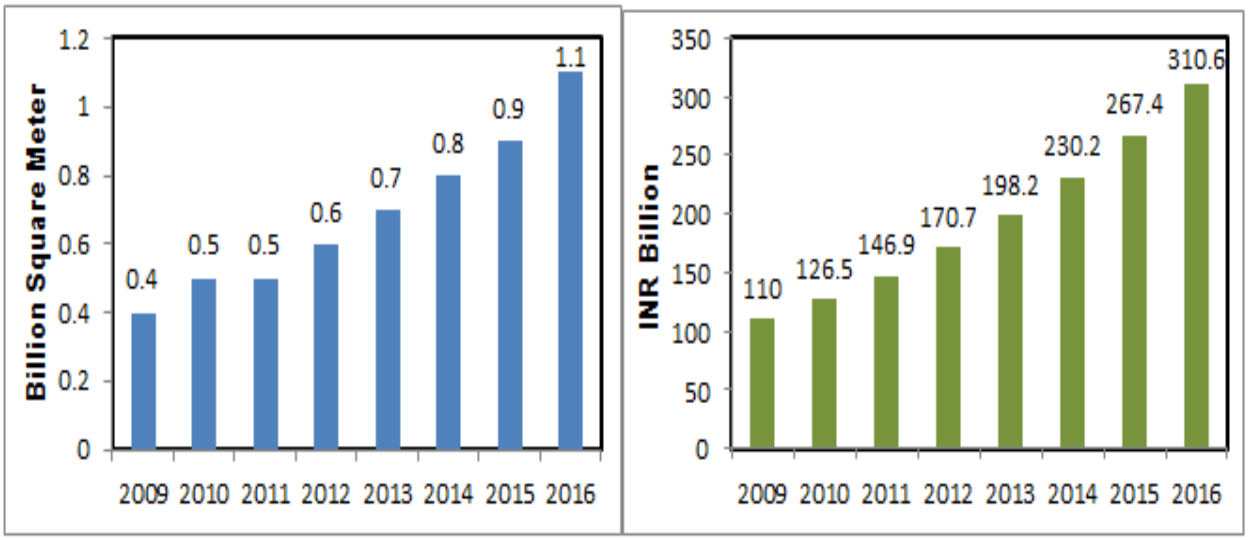
Figure 2.4.1: Market Shares of Tile Products by Value (2012)

The Organized/ National sector consists of 14 major players and their share of production is 40 %. The unorganized/ regional sector consists of approximately 200 units (70% based in Gujarat) and their share of production is 60%.

2.4.2 Growth in past and future prospective

Global tiles market has witnessed ups and downs in the last few years due to 2009 crisis. However, the global tiles market has shown an upward trend since 2010 with the major demand coming from emerging economies. The growing real estate market in countries such as Brazil, India, China and Indonesia has led to the demand for tiles. During 2011, India was the 20th largest ceramic trading nation in the world and accounted for a share of around 1% in total ceramics trade. During the period, from 2001 to 2011, India's ceramics trade increased from US$ 143 million to US$ 984 million at a CAGR of 23.4%. The increase in trade was led by rise in imports, which increased, from US$ 68.7 million in 2001 to US$ 750.9 million in 2011, at a CAGR of 26.3%. India's ceramic exports on the other hand increased at a CAGR of 11.6%, from US$ 82.3 million to US$ 233.3 million.

As on 2012, the global and Indian domestic market CAGR are 11 % & 15 % respectively. According to the recently published report by TechSci Research, "India Tiles Market Forecast & Opportunities, 2017" tiles market in India is expected to witness compounded annual growth rate of around 18% during 2012-2017. With the high number of people moving from rural to urban areas, increasing income, demand for luxury housing and dropping prices of tiles has all led to the increased demand for tiles in the country. Figure 2.4.2 below gives the recent trends and projections in terms of volume as well as by value.

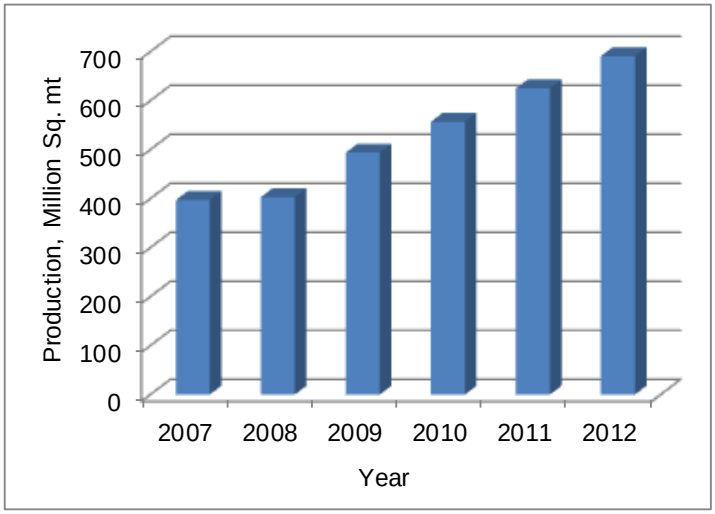


Source: Netscribes

Figure 2.4.2: Market Sizes of Ceramic Tiles (Volume & Value)

2.5 Production data

India's ceramic production figures over the last six years are given in figure 2.5 below.



Source: Tile Today

Figure 2.5: Indian Ceramics Production data

2.6 Important Stakeholders

The important stakeholders of this sector include industry associations, government bodies, manufacturing facilities, equipment manufacturers and raw material suppliers. There are a number of brick manufacturing companies who also form a part of the stakeholders. Under the unorganized sector, Asian and Suman are two of the major stakeholders. Apart from this, *The Indian Council of Ceramic Tiles and Sanitaryware (ICCTAS)* is another important stakeholder. The purpose of this registered body is to spread awareness on the benefits and attributes of ceramic tiles and sanitaryware, work towards establishing quality, service and customer orientation in the industry. Members of the council are all leading brands and organizations in the country, which follow the standards, set by ICCTAS.

Other stakeholders include the state wise industrial development departments like the Directorate of Industries and Commerce (DIC), Tamil Nadu, Rajasthan State Industrial Development and Investment Corporation Limited, Farmers' Associations.

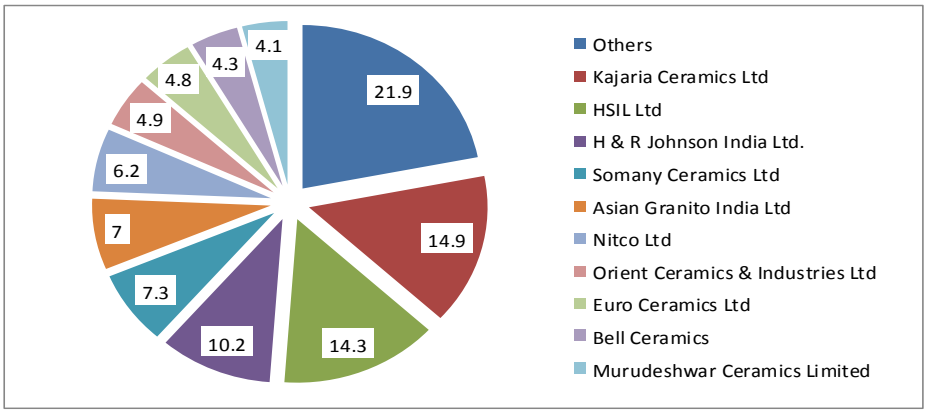
2.7 Product categorization

The broad categorisation of ceramic based on the type of products is given below.

1. Wall tiles
2. Floor tiles
3. Vitrified tiles
4. Sanitary ware

2.8 Major players

National brands control over 50% of the industry. The market share of major players in Indian Ceramic Industry is given in figure 2.8.



Source: Prowess, CMIE

Figure 2.8 : Market Share of Major Players in Ceramic Industry

2.9 Regulatory/Policy Scenario

(i) Raw material availability

Feldspar and quartz are critical raw materials in the manufacturing of ceramic tiles and sanitary ware. The global demand for these rare minerals has been growing forcing the domestic industries to rely heavily on imports of these inputs. The export of both raw materials has gone up substantially and hence the Board of Indian Council of Ceramic Tiles and Sanitary ware (ICCTAS) has already appealed to the government for ban on export of these raw materials. Another issue faced by ceramic product manufacturers is the curtailing of imports of Boric acid, used as an additive to enhance glaze appearance and improve chemical and mechanical durability. But it is classified as insecticide by the Central Insecticide Board and hence is not freely allowed to be imported.

(ii) High fuel prices

High fuel price, especially of natural gas, is a major challenge faced by the ceramic industry, and has been one of the key reasons affecting the profitability of the ceramic industry. Analysis shows that the share of power, fuel and water expenses in total sales had gone up from 10.8% in 2010-11 to about 13% in 2011-12.

(iii) Dumping

One of the major problems faced by the Indian tile manufacturers is dumping. Cheap imported vitrified tiles are being dumped by countries such as China. Such cheap imports have threatened the viability, especially of units in the vitrified tile segment. Government of India had levied an anti-dumping duty on import of vitrified tiles from China in 2003 based on the findings of anti-dumping cases. Anti-dumping duty was imposed by the Government of India during May 2003 for different ceramic products originating/ exported from China. However, the anti-dumping duty has expired in June 2013.

(iv) Quality and scale economies

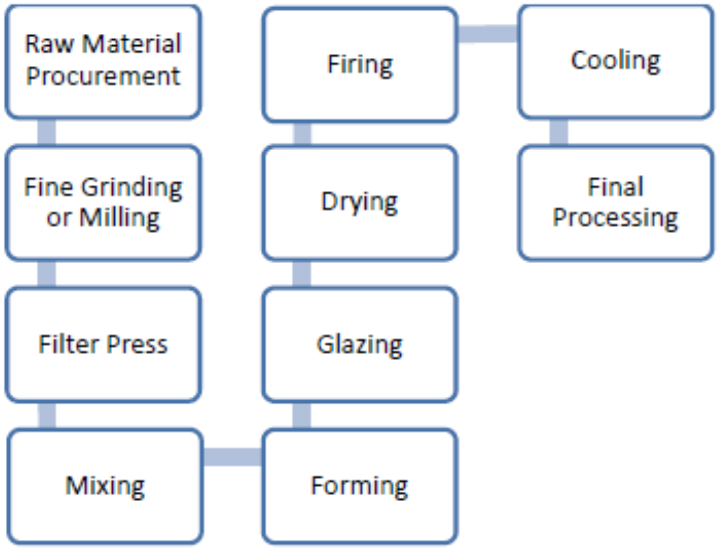
The ceramic tiles industry is dominated by unorganized players with a market share of approximately 60%. The major ceramic cluster is Morbi in Gujarat which still uses obsolete technologies for production and printing, except for few organised players.

3.0 Energy performance

3.1 Sectorial level energy performance in recent years

Ceramic Manufacturing Process:

Figure below shows the general process flow diagram of ceramic manufacturing process.



(i) Raw Materials Procurement & Weighing

The raw materials used in the manufacture of ceramics range from relatively impure clay materials mined from natural deposits to ultrahigh purity powders prepared by chemical synthesis. Naturally occurring raw materials used to manufacture ceramics include silica, sand, quartz, flint, silicates, and aluminosilicates. The first step in the process is to weigh the raw materials required to manuacture a ceramic tile including all types of frit, feldspar and various clays. All the raw materials are accurately weighed, so that the quality of the product can be stabilized.

(ii) Fine Grinding & Milling

The basic beneficiation processes include crushing, grinding, and sizing or classification. Primary crushing is used to reduce the size of coarse materials, such as clays, down to approximately 1 to 5 centimeters. The most common types of crushers used are jaw crushers, cone crushers, gyratory crushers, and roll crushers. Secondary crushing or grinding reduces particle size down to approximately 1 millimeter in diameter. Fine grinding or milling reduces the particle size down to as low as 1.0 micrometer in diameter. Ball mills are the most commonly used piece of equipment for milling.

(iii) Filter Press

During the process to make clay and ceramic slurries used for the manufacture of dinnerware, insulators, china etc, the clay slurry goes through a dewatering step prior to further processing and molding into the desired form. These slurries are extremely dense and heavy and typically require dewatering at 225 PSI feed pressure to obtain a solid cake.

(iv) Mixing

The purpose of mixing or blunging is to combine the constituents of a ceramic powder to produce a more chemically and physically homogenous material for forming. Pug mills often are used for mixing ceramic materials. Several processing aids may be added to the ceramic mix during the mixing stage. Binders and plasticizers are used in dry powder and plastic forming; in slurry processing, deflocculants, surfactants, and antifoaming agents are added to improve processing. Liquids also are added in plastic and slurry processing. Binders are polymers or colloids that are used to impart strength to green or unfired ceramic bodies.

Mixing ensures a uniform distribution of clay in the solution. It also prevents the sedimentation of clay which is desirable for the process of ceramic formation. Pug Mills are most commonly used for mixing in ceramic production.

(v) Spray Drying

Ceramic tiles are typically formed by dry pressing. Prior to pressing, many facilities granulate the ceramic mix to form a free-flowing powder, thereby improving handling and compaction. The most commonly used method of granulation is spray-drying. The slurry is injected into a drying chamber with hot gases. As the hot gases come in contact with the slurry, a powder is formed and collected in a cyclone or fabric filter. Spray dryers generally are gas-fired and operate at temperatures of 70° to 570°C. After spray drying, the water content of the granules is between 35-40%.

(vi) Powder Storage

The granules have to be kept in a storage bin for a few days so that its composition becomes even more homogeneous. This process makes the granules more pliable and less likely to stick to the mold. The size of powder storage bin needed will be determined by the production capacity of the plant. Generally, the most suitable size is capable of holding 400 tons of powder.

(vii) Shaping

In the forming step, the ceramic mix is consolidated and molded to produce a cohesive body of the desired shape and size. Forming methods can be classified as either dry forming, plastic molding, or wet forming. Once the composition of the powder becomes homogenous, it is taken to the press where it is molded and squeezed under high pressure (of the order of hundreds of tons) to form a biscuit or Greenware tile body. The press can be for a small trim tile or a massive 24x24 inch tile.

(viii) Glazing

Glazes resemble glass in structure and texture. The purpose of glazing is to provide a smooth, shiny surface that seals the ceramic body. Not all ceramics are glazed. Those that are glazed can be glazed prior to firing, or can be glazed after firing, followed by refiring to set the glaze.

(ix) Car Storage

After glazing, the biscuit is loaded into the stock car for storage, which is proceeded by the fully-automatic hydraulic controlled system.

(x) Speed Body Drying

The drying process in the ceramic industry is the greatest energy consumer second to the firing process. Drying means loss of moisture from the surface of the substance by evaporation, and the drying speed depends on the temperature and humidity. When the substance is dried and moisture is lost, particles are put close to each other, resulting in shrinkage.

(xi) Firing

Firing is the process by which ceramics are thermally consolidated into a dense, cohesive body composed of fine, uniform grains. This process also is referred to assintering or densification. Ceramics generally are fired at 50-75% of the absolute melting temperature of the material.

Ceramic products also are manufactured by pressure firing, which is similar to the forming process of dry pressing except that the pressing is conducted at the firing temperature. The application of pressure enhances the densification of the ceramic during firing. Because of its higher costs, pressure firing is usually reserved for manufacturing ceramics that are difficult to fire to high density by conventional firing. In hot pressing, hydraulic presses and graphite dies commonly are used. In hot isostatic pressing, the pressing medium typically is a gas, such as argon or nitrogen.

(xii) Packing

The finished products are then packed and stored or shipped.

Energy Performance:

The primary energy use in ceramic manufacturing is for kiln. Natural gas, LNG and fuel oil are employed for most drying and firing operations. Nearly 30 % of the energy consumed is used for drying. Over 60 % of the energy consumed is used for firing. The percentage of the energy cost in the total ceramic production cost is between 5 and 20%, although it varies according to the product type and fuel price. Percentage share of electrical and thermal energy consumption in a typical ceramic industry varies from 15 – 20% and 75 – 80% respectively. Typical thermal and electrical specific energy consumption range for different sub processes/ kilns/ type of firing in ceramic tile and sanitaryware manufacturing process is given in table below.

Table 3.1.1 : Specific Energy Consumption in ceramic tiles and sanitaryware manufacturing

Particulars	Unit	Industry benchmark
Ceramic Tiles		
Thermal Energy		
1. Spray drying	kJ/ kg	980– 2200
2. Drying process	kJ/ kg	250 – 750
3. Firing		
Tunnel Kilns		
Once fired tiles	kJ/ kg	5400 – 6300
Twice fired tiles	kJ/ kg	6000 – 7300

Particulars	Unit	Industry benchmark
Roller Hearth Kilns		
Once fired tiles	kJ/ kg	1900 – 4800
Twice fired tiles	kJ/ kg	3400 – 4600
Electrical Energy		
1. Pressing	kWh/ kg	50 – 150
2. Drying	kWh/ kg	10 – 40
3. Firing	kWh/ kg	20 – 150
Sanitaryware		
Conventional Tunnel Kiln	kJ/ kg	9100 – 12000
Modern Tunnel Kiln	kJ/ kg	4200 – 6500
Roller Hearth Kiln	kJ/ kg	3500 – 5000
Modern Shuttle Kiln	kJ/ kg	8500 - 11000

The 'specific energy consumption' (SEC) figures in ceramic sector for different products range are given in table 3.1.2. As there was no energy consumption details available for the major players in the public domain, below mentioned specific energy consumption figures were considered to estimate the energy consumption for all the major players based on the available capacity details.

Table 3.1.2: Standard Specific Energy Consumption Range for Ceramic Products

Product	Electrical energy		Thermal energy*	
	Value	Unit	Value	Unit
Vitrified tiles	3.71 – 5.01	kWh/ m^2	1.51 – 2.11	SCM/ m^2
Wall & floor tiles	1.51 – 1.92	kWh/ m^2	1.28 – 1.8	SCM/ m^2

Source: SEE – Tech Solutions Pvt. Ltd Report on Energy Conservation in Ceramic Sector
**Natural gas*

3.2 International comparison

The SEC levels for wall and roof tiles in ceramic manufacturing in India, China and Italy are given in table 3.2.

Table 3.2: Comparison of SEC Level of Other Countries

Country	Specific energy consumption	
	Electrical (kWh/tonne)	Thermal (million kcal/tonne)
India	210	1.34
China	259	1.05
Italy	139	1.16

Source: SIDBI Booklet

3.3 Technological movements

Tunnel kilns and roller hearth kilns (roller kilns) are used for continuous firing. The primary advantages of tunnel kilns and roller kilns are lower energy consumption and the ease with which the ceramics can be transported through the firing process when compared to batch type kilns. A large number of tunnel and roller kilns use natural gas as fuel. Bell and shuttle kilns are used for batch type production of ceramic products. The main advantage of batch type kilns is that they can readily accommodate changes in firing temperature profile and cycle time to match the requirements of a wide variety of ceramic products.

3.4 Capacity utilization

The average capacity utilization of major players in ceramic sector is about 75% (source: Prowess, CMIE database). The capacity utilization of major players is given in table 3.4.

Table 3.4 : Capacity Utilization of Major Players in Ceramic Industry

Sl. No.	Plant	Capacity utilization (%)
1.	Kajaria Ceramics Limited	68
2.	H & R Johnson	72
3.	Somany Ceramics Ltd	91
4.	Nitco Ceramics Ltd	74
5.	Asian Granito Ltd	*
6.	RAK Ceramics	*
7.	Orient Ceramics & Industries Ltd	81
8.	Bell Ceramics Ltd	84
9.	Varmora Granito Pvt Ltd	NA
10.	Regency Ceramics	NA
11.	Murudeshwar Ceramics Ltd	53
12.	Euro Ceramics	67

**Data Not Available*

3.5 Major energy consuming areas

Energy consumption in ceramic industry depends on payload of ceramic products, effectiveness and efficiency of various equipments. An indication of energy consumption of different processes in ceramic products manufacture is given figure 3.5.

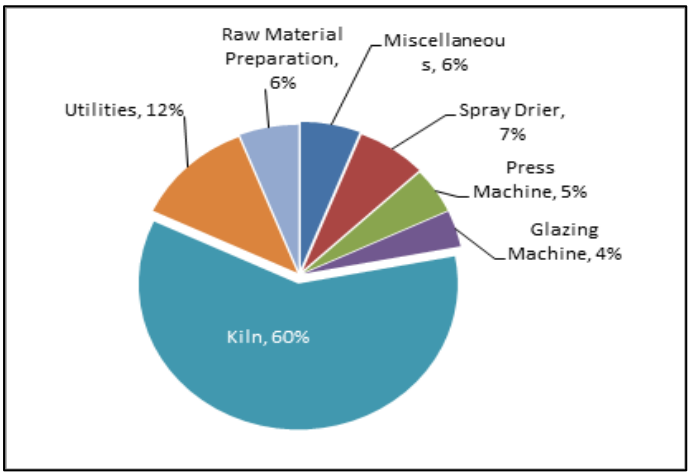


Figure 3.5: Energy Breakup of Ceramic Industry

3.6 Energy saving potential and major areas

The Indian ceramic industry offers significant scope for energy efficiency improvements. Some of the common technological options applicable for ceramic industry are given below.

- *Tunnel kiln*.Waste heat recovery, low thermal mass cars in sanitary-ware units, use of hot air directly as combustion air, use of hot air from cooling zone to preheat input material
- *Roller kiln*.Maintain air-fuel ratio, improving insulation, preheating of combustion air using flue gases/ hot air from cooling zone, energy efficient burner that can handle high temperature hot air
- *Ball mill/ blunger*.Continuous multi-stage ball mill
- *Spray dryer*. fuel switching to NG
- Use of 'variable frequency drive' (VFD) in ball mills, blunger and agitation motors, presses and blowers
- Use of energy efficient motors in agitation systems and polishing line
- Improvement of kiln insulation
- Solar preheating of spray dryer input slurry
- Biomass/ briquette firing in hot air generator
- Cogeneration system in NG based ceramic industries.

4.0 Analysis of energy consumption data

4.1 Methodology

The total energy consumption of individual ceramic industry is not readily available. In order to estimate the energy consumption following assumptions were made.

- Energy consumption and production details were not available for most of the plants in unorganized sectors. Average specific energy consumption figures for different type of ceramic products given in table 4.1 were used to estimate the energy consumption of each plant where data is not available.

Table 4.1: SEC Range of ceramic products

Product	Electrical energy		Thermal energy *	
	Range	Unit	Range	Unit
Vitrified tiles	3.71 – 5.01	kWh/ m^2	1.51 – 2.11	SCM/ m^2
Wall & floor tiles	1.51 – 1.92	kWh/ m^2	1.28 – 1.8	SCM/ m^2

**In terms of Natural Gas*

- Operating production capacity were estimated considering 75% capacity utilization factor (Average capacity utilization among major players based on CMIE Prowess data).
- Estimated Mtoe figures include both own plants and joint ventures as there was no separate data available. Wherever data is available separately for each plant, the same data has been used.
- In order to calculate the total energy consumption in terms of Mtoe, the following method was adopted.
- There were no installed capacity/ production data available separately for most of the companies manufacturing sanitaryware and tableware. Hence the same was not included in the report.

Total electrical energy consumption (kCal)
= Installed capacity (m^2) X capacity utilization (%) X SEC (kWh/ m^2) X 860 (kCal/ kWh)

Total thermal energy consumption (kCal)
= Installed capacity (m^2) X capacity utilization (%) X SEC (kCal/ m^2)

Total energy consumption (MTOE)
= [Thermal energy consumption (kCal) + Electrical energy consumption (kCal)]/ 10^7

4.2 Estimated energy consumption of major industries

The estimated annual energy consumption of major ceramic industries in India covering both organized and unorganized sector is given in table 4.2.1.

Table 4.2.1: Estimated energy consumption of major ceramic industries

Sl. No	Plant	Capacity				Energy consumption (Mtoe/year)	Source
		Installed		Production			
		MSM	MTPA	MSM	MTPA		
Organized sector							
1.	Kajaria Ceramics Ltd, Galipur Unit, Rajasthan	21.5	-	16.1*	-	39,410	CMIE Prowess Data, Annual Report
2.	Kajaria Ceramics Ltd, Sikandrabad Unit, Uttar Pradesh	8.4	-	6.3*	-	13,230	CMIE Prowess Data, Annual Report
3.	H & R Johnson Ltd	-	332720	-	276965	43,634	CMIE Prowess Data, Online Data
4.	Somany Ceramics Ltd	19.147	-	14.4*	-	35,096	CMIE Prowess Data, Annual Report
5.	Nitco Ceramics	8.085	-	6.1*	-	14,820	CMIE Prowess Data, Annual Report
6.	Asian Granito India Limited	-	-	5.2	-	13,084	BEE Energy Conservation Award Document
7.	RAK Ceramics	10.5	-	7.9*	-	19,247	Online Data
8.	Orient Ceramics & Industries Ltd	-	220000	-	184065	25,400	CMIE Prowess Data, Online Data
9.	Bell Ceramics Ltd	10.837	-	8.1*	-	19,864	CMIE Prowess Data, Online Data
10.	Varmora Granito Ltd		150000	-	112500	16,801	Online Data
11.	Regency Ceramics		-	9.3	-	22,741	CMIE Prowess Data, Online Data
12.	Murudeshwar ceramics Ltd	11.4	-	4.1	-	10,018	CMIE Prowess Data, Online Data
13.	Euro Ceramics	-	151971	-	101940	16,039	CMIE Prowess Data, Online Data
Unorganized Sector							
14.	Soriso Ceramic Pvt Ltd	4.6	-	4.4	-	10,680	ICRA Rating Publication
15.	Jaxx Vitrified Pvt Ltd	5.7	-	5.5	-	13,513	Online Data
16.	Vennar Ceramics Pvt Ltd	2.3	-	2.2	-	5,340	Online Data
17.	Cosa Ceramics	2.7	-	2.5	-	6,137	Online Data

Sl. No	Plant	Capacity				Energy consumption (Mtoe/year)	Source
		Installed		Production			
		MSM	MTPA	MSM	MTPA		
18.	Antique Marbonite Pvt Ltd	9.69	-	7.3*	-	17,762	ICRA Rating Publication
19.	Cengress Tiles	2.38	-	1.785*	-	4,363	Online Data
20.	Regent Granito (I) Ltd	6.12	-	4.59*	-	11,218	Online Data
21.	Coral Ceramics Pvt Ltd	-	50000	-	37500*	5,900	Online Data
22.	Coral Granito Pvt Ltd	-	75000	-	56520*	8,850	Online Data
23.	Senso Granito Pvt Ltd	-	95000	-	71250*	11,211	ICRA Rating Publication
24.	Sentini Ceramica Pvt Ltd	17	-	12.75*	-	31,161	Online Data
25.	Silica Ceramica Pvt Ltd	8.67	-	6.50*	-	15,892	Online Data
26.	Asian Tiles Limited	27.54	-	20.655*	-	50,481	ICRA Rating Publication
27.	Jalaram Ceramics	-	79000	-	59250*	9,323	Online Data
28.	Sunshine Tile Co Pvt Ltd	20.4	-	15.3*	-	37,393	Online Data
29.	Swastik Ceracon Ltd	10.2	-	7.65*	-	18,697	Online Data
30.	Umiya Ceramics Pvt Ltd	1.663	-	1.24*	-	3,048	Online Data
31.	Oracle Granito Pvt Ltd, Gujarat	4.76	-	3.57*	-	8,725	Online Data
32.	Century Tiles Ltd	6.12	-	4.59*	-	11,218	Online Data
33.	City Tiles Ltd	4.42	-	3.315*	-	8,102	Online Data
34.	Decolight Ceramics Ltd	4.08	-	3.1*	-	7,479	Online Data
35.	Restile Ceramics Ltd, Hyderabad, AP	3.6	-	2.7*	-	6,599	Online Data
36.	Sorento Granito Pvt Ltd	4.08	-	3.1*	-	7,479	Online Data
37.	Victory Ceratech Pvt Ltd, Gujarat	3.74	-	2.8*	-	6,855	Online Data
38.	Simpolo Vitrified Pvt Ltd	10.88	-	8.2*	-	19,943	Online Data

**Production calculated based on 75% capacity utilization (Average for Major Players based on CMIE Prowess Data)*
Considered SEC – 21000 kCal/m2; 4 kWh/m2; 225 kWh/Tonne; 1.38 Million kCal/Tonne;

The distribution of the units based on total energy consumption is given in table 4.2.2. As can be seen, the energy consumption of all the major ceramic industries in organised as well as unorganised sectors is estimated to be more than 3000 mtoe.

Table 4.2.2: Distribution of Units Based on Energy Consumption

Range of energy consumption (toe)	Number of units
3000 – 5000	2
5001 – 10000	11
10001 – 15000	9
15001 – 20000	8
> 20000	8

4.3 Possible energy efficiency measures for key processes/ systems

The major energy efficiency measures in various processes as well as utilities in ceramic industries are provided below.

(1) Kiln

- Switching from intermittent type to continuous type kilns
- Auto interlock between brushing dust collection blowers and glazing lines
- Adopting best operating practices including optimizing of excess air levels

(2) Spray dryer

- Replacing LPG firing with diesel firing
- Arresting air infiltration in spray drier system

(3) Vertical dryer

- Switch off chiller circuit when hydraulic press is not in operation
- Installing interlock to avoid idle operation of hydraulic press pump

Apart from these, there are a number of energy conservation options in utilities that vary from simple housekeeping measures to switching over to energy efficient equipment that can be adopted by ceramic industries.

5.0 Conclusions

In India there are about 13 major ceramic players in organized sector and 25 ceramic plants in unorganized sector with capacities varying from 1.6 to 54 MSM. The average capacity utilization of the major players in ceramic industry is about 75%. The energy consumption of the ceramic industry is dependent on different factors such as type of products, capacity utilization, type of fuels used, technology adopted, etc. The estimated annual energy consumption of these 38 ceramic plants varies between 3000 toe to 50000 toe. Of these, the annual energy consumption of 36 plants is estimated to be more than 5000 toe. This energy consumption level is more than the minimum annual energy consumption for designated consumers (DCs) set for textile industries. Therefore it is suggested that these 36 plants may be included as DCs under the PAT scheme with a threshold limit of 5000 toe as the minimum annual energy consumption per plant (figure 5.0). There exists an energy saving potential of 5–14% by adoption of energy efficiency measures in process and utilities.

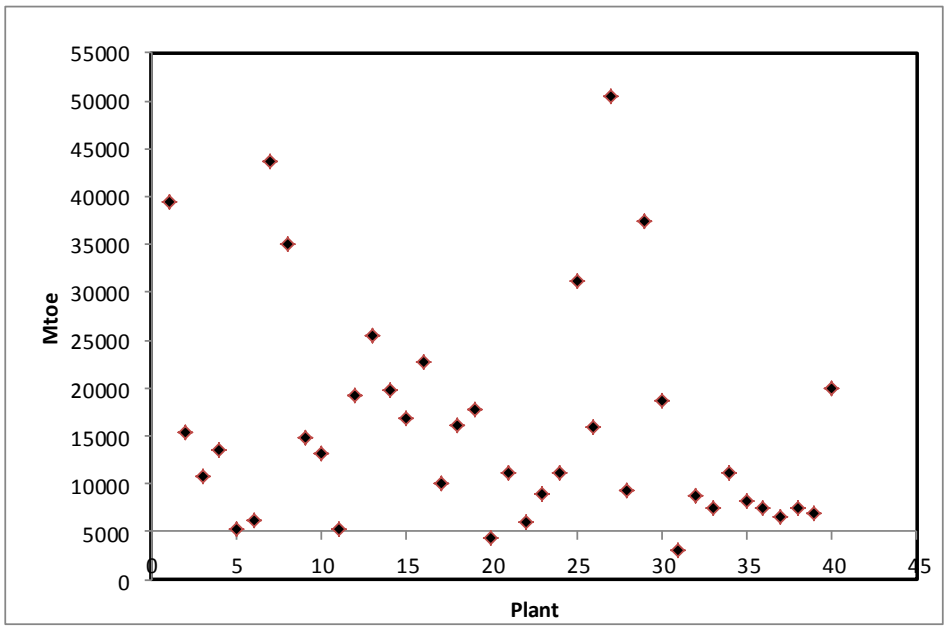


Figure 5.0: Proposed threshold limit for ceramic industry

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